

Otsego Lake limnological monitoring, 2008

Matthew F. Albright and Holly Waterfield

ABSTRACT

Limnological analyses of several abiotic factors were performed during 2008 on Otsego Lake, Cooperstown, N.Y. The purpose was to monitor the chemical and physical parameters affecting water quality for comparison with past findings. This work is part of an ongoing study begun over thirty years ago. Throughout the year, profiles of water temperature, dissolved oxygen, pH and conductivity were measured using a Hydrolab Scout 2[®], a Hyrdolab Surveyor 4[®] or a Eureka Amphibian/Manta[®] at the deepest spot in the Lake (TR4-C). Water samples were collected in profile for the analyses of total phosphorus, nitrite+nitrate, ammonia, total nitrogen, calcium, chloride, and alkalinity. Secchi disk transparency was measured. The data, after comparison with earlier information, indicate that water quality varies in relation to the volume of cold water fish habitat in late summer. These changes are attributed to fluctuations in nutrient loading, weather conditions, and food web alterations due to the proliferation of the alewife.

INTRODUCTION

Otsego Lake is a glacially formed, dimictic lake supporting a cold water fishery. The Lake is generally classified as being chemically mesotrophic, although flora and fauna characteristically associated with oligotrophic lakes are present (Iannuzzi, 1991).

This study is the continuation of year-round protocol that began in 1991. The data collected in this report run for the calendar year and are comparable with contributions by Homburger and Buttigieg (1992), Groff et. al.(1993), Harman (1994; 1995) Austin et al. (1996), and Albright (1997; 1998; 1999; 2000; 2001; 2002; 2003; 2004; 2005; 2006; 2007; 2008). Concurrent additional work included descriptions of the zooplankton (Albright 2009) and nekton communities (Lydon et al. 2009; Byrne et al. 2009, Waterfield 2009) and estimates of fluvial nutrient inputs (Denby 2009).

MATERIALS AND METHODS

Readings were collected bi-weekly during open water conditions and monthly through the ice. However, because of unsafe ice conditions, data were only collected between 12 February and 2 December.

Data were collected near the deepest part of the Lake (TR4-C) (Figure 1), which is considered representative as past studies have shown the Lake to be spatially homogenous with respect to the factors under study (Iannuzz 1991). Physical measurements were recorded at 2 m

intervals between 0 and 20 m and 40 m to the bottom; 5 meter intervals were used between 20 and 40 m. Measurements of pH, temperature, dissolved oxygen and conductivity were recorded on site with the use of a Hydrolab Scout 2[®], a Hydrolab Surveyor 4[®] or a Eureka Amphibian/Manta[®] multiprobe digital microprocessor which had been calibrated according to manufacturer's instruction immediately prior to use (Hydrolab Corp. 1993; Eureka Environmental Engineering 2005). Samples were collected for chemical analyses at 4 m intervals between 0 and 20 m and 40 m and the bottom; 10 m intervals were used between 20 and 40 m. A summary of methodologies employed for chemical analyses are given in Table 1. Composite samples were collected from the surface to 20 m for Chlorophyll *a* measurements, which were determined using a Turner Designs TD-700[®] fluorometer following the methods of Welschmeyer (1994).

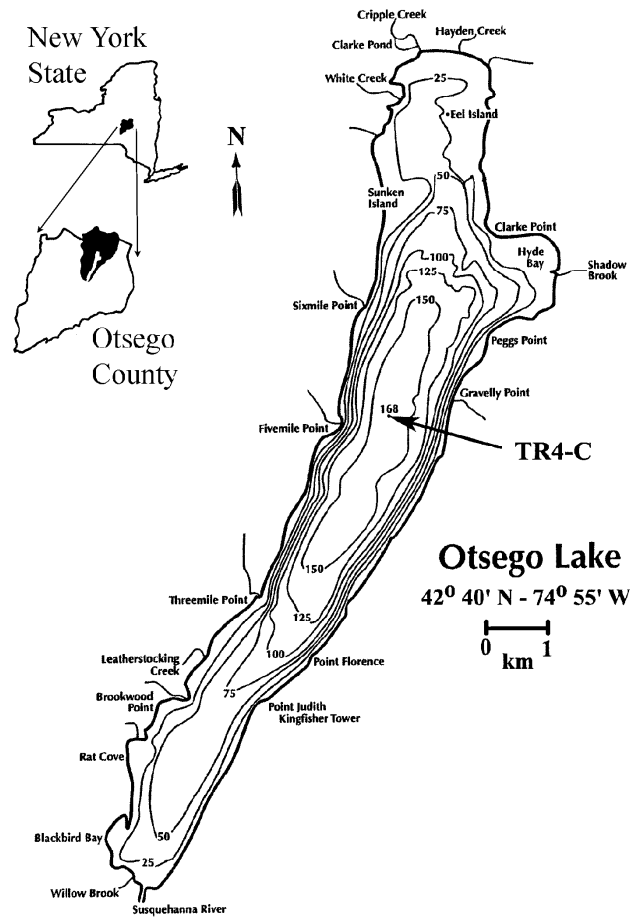


Figure 1. Bathymetric map of Otsego Lake showing sampling site (TR4-C).

Parameter	Sample volume	Preservation	Method	Reference
Total Phosphorus-P	10 ml	H ₂ SO ₄ to pH<2	Persulfate digestion followed by single reagent ascorbic acid	Liao and Marten 2001
Total Nitrogen-N	5 ml	H ₂ SO ₄ to pH<2	Cadmium reduction method following peroxodisulfate digestion	Pritzlaff 2003; Ebina et. al 1983
Nitrite+Nitrate-N	10 ml	H ₂ SO ₄ to pH<2	Cadmium reduction	Pritzlaff 2003
Ammonia-N	10 ml	H ₂ SO ₄ to pH<2	Phenolate	Liao 2001
Calcium	50 ml	None	EDTA titrimetric	EPA 1983
Chloride	100 ml	None	Mercuric nitrate titration	APHA 1989
Alkalinity	100 ml	Cool to <4°C, measure ASAP	Titration to pH=4.6	APHA 1989
Chlorophyll <i>a</i>	100 ml	Ice sample, filter ASAP, process in reduced light	Fluorometric	Welshmeyer 1994

Table 1. Summary of laboratory methodologies.

RESULTS AND DISCUSSION

Temperature

Surface temperature reached a high of 23.48 C° on 31 July. The lake was completely covered by ice on 27 January. The lake was completely ice-free on 9 April. Stratification was evident by 8 May.

Dissolved Oxygen

Dissolved oxygen concentrations ranged from surface readings of 15.54 mg/l just under the ice on 12 February to 0.83 mg/l at the bottom on 7 November. Year long profiles are given in Figure 2. Areal hypolimnetic oxygen depletion rates, at 0.088 mg/cm²/day, were comparable to those of recent years, an improvement compared to depletion rates calculated throughout the 1990s (Table 2), but are still over the lower limit of euryphy (0.05 mg/cm²/day) suggested by Hutchinson (1957).

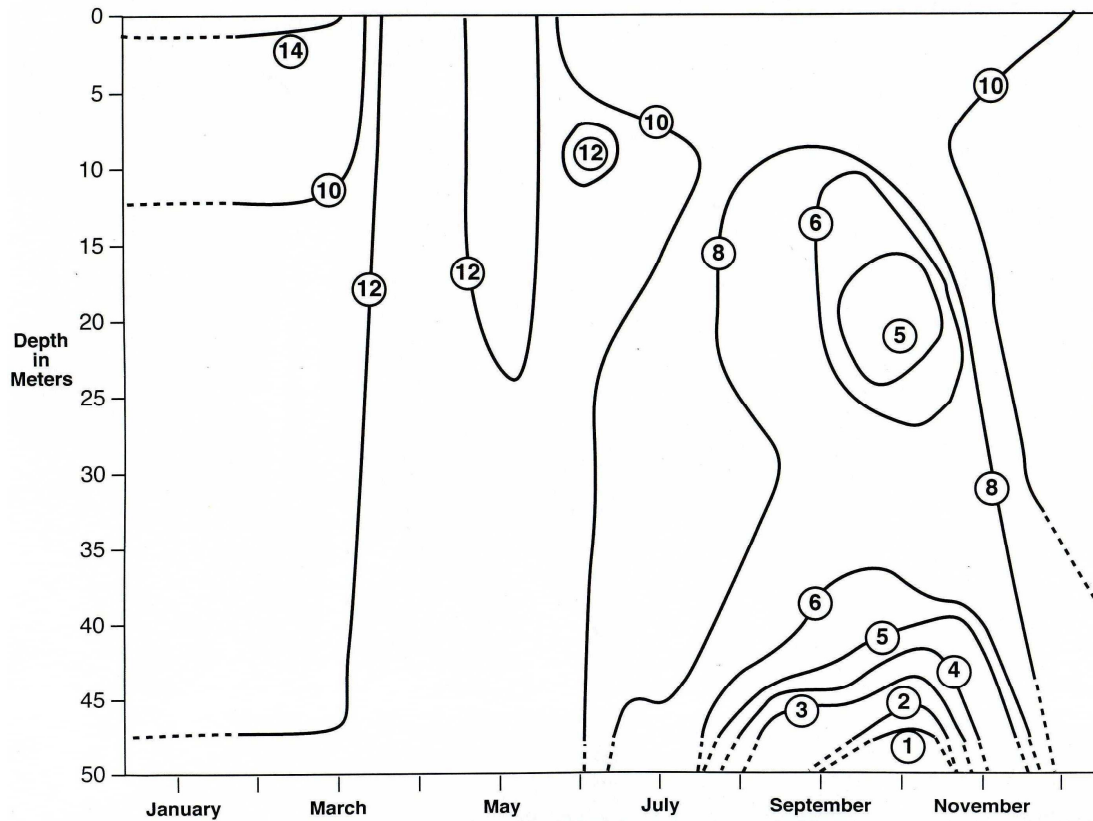


Figure 2. Otsego Lake oxygen profiles, 2008. Isoleths in mg/l.

Conductivity

Conductivity (an indirect measure of ions in solution) values ranged from 227 $\mu\text{mhos/cm}$ just under the ice on 13 March to 317 $\mu\text{mhos/cm}$ at 48 m on 15 August.

Alkalinity

Alkalinity averaged 119 mg/l (as CaCO_3) throughout the year. The minimum value of 91 mg/l was observed just under the ice on 13 March; the maximum value (130 mg/l) occurred on the same date at 48m.

Calcium

Calcium concentrations averaged 48.4 mg/l over the course of 2008. A low of 36.1 mg/l was observed just under the ice on 13 March, while the highest value (56.1 mg/l) was obtained on 3 July at depths of 44m and 48m.

Interval	AHOD (mg/cm ² /day)
05/16/69 – 09/27/69	0.080
05-30-72 – 10/14/72	0.076
05/12/88 – 10/06/88	0.042
05/18/92 – 09/29/92	0.091
05/10/93 – 09/27/93	0.096
05/17/94 – 09/20/94	0.096
05/19/95 – 10/10/95	0.102
05/14/96 – 09/17/96	0.090
05/08/97 – 09/25/97	0.101
05/15/98 – 09/17/98	0.095
05/20/99 – 09/27/99	0.095
05/11/00 – 09/14/00	0.109
05/17/01 – 09/13/01	0.092
05/15/02 - 09-26/02	0.087
05/16/03 – 09/18/03	0.087
05/20/05 – 09/24/05	0.102
05/27/05 – 10/05/05	0.085
05/05/06 – 09/26/06	0.084
05/18/07 – 09/27/07	0.083
05/08/08 – 10/07/08	0.088

Table 2. Areal hypolimnetic oxygen deficits (AHOD), Otsego Lake computed over summer stratification in 1969, 1972 (Sohacki, unpubl.), 1988 (Iannuzzi, 1991) and 1992-2008.

Chlorides

Chloride concentrations averaged 14.6 mg/l, exhibiting very little variation either temporally or spatially (ranging from 13 to 16 mg/l). Between 1985 and 2005, chlorides concentrations had been increasing by 0.5 to 1.0 mg/l, presumably attributable to road salting. However, since then the mean concentrations have been directionally variable. (Figure 3).

Nutrients

Total phosphorus-P averaged 7.8 μ g/l. There was no evidence of phosphorus release from the sediments prior to fall turnover, as had been suggested following 1995 monitoring (Harman et al. 1997). Nitrite+nitrate-N averaged 0.47 mg/l over the course of the year. Ammonia was generally below detectable levels (< 0.02 mg/l). Total nitrogen averaged 0.70 mg/l. This implies that organic nitrogen averaged about 0.2 mg/l over the year.

Secchi disk transparency and chlorophyll *a*

Summertime (May-October) water transparency averaged 3.1 m and ranged from 2.0 m on 5 June to a high of 4.0 m on 19 September and 7 October. Figure 4 summarizes the annual mean summer (May-October) Secchi transparencies at TR4-C in 1935, 1968-73, 1975-82, 1984-87, 1988, and 1992-08. Composite chlorophyll *a* samples averaged 4.1 mg/l and ranged from 2.0 on 28 August to 6.4 on 21 May.

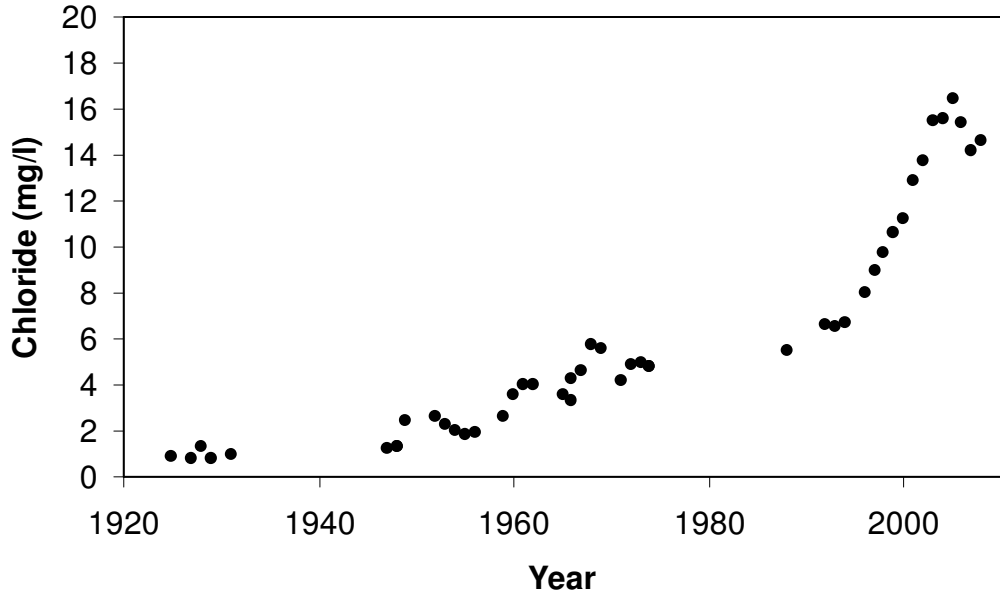


Figure 3. Mean chloride concentrations at TR4-C, 1925-2008. Points later than 1990 represent yearly averages (modified from Peters 1974).

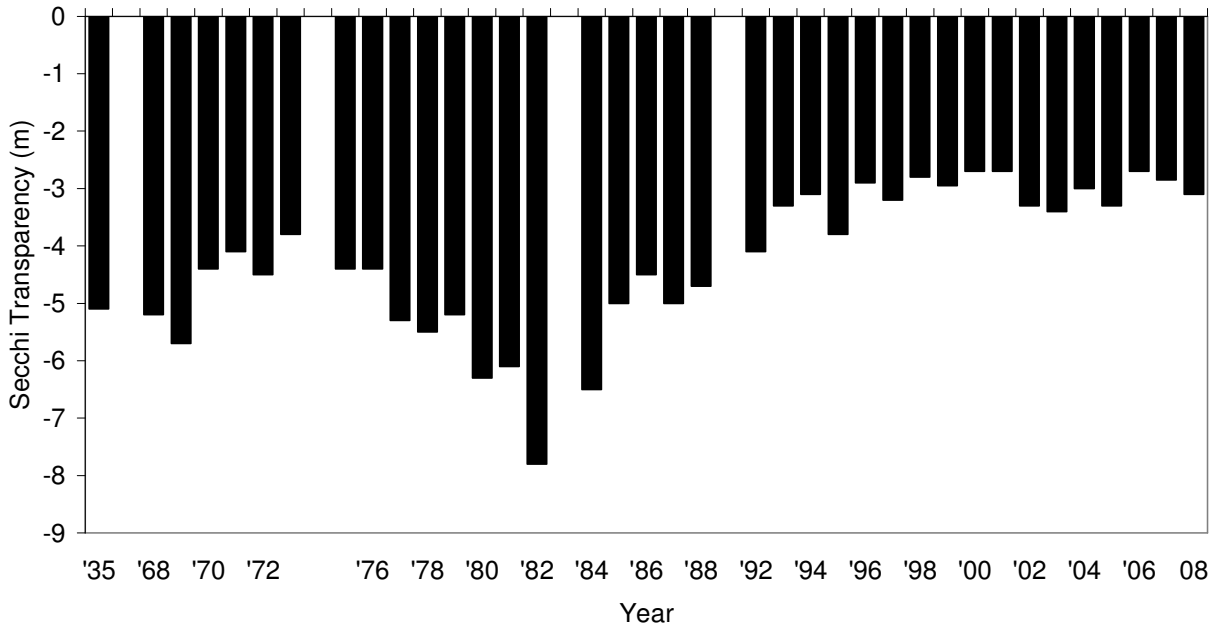


Figure 4. Mean summer (May-October) Secchi transparencies collected at TR4-C, 1935-2008.

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